Model
S-10
SERVO CONTROL AMPLIFIER

IN ALL CORRESPONDENCE WITH THE FACTORY BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

FROM SERIAL NO. _____

TO SERIAL NO. _____

LING NO. 41850

UNIT SERIAL NO. 388

MP MASTER
MA34226

LING ELECTRONICS Division
LING-TEMCO-VOUGHT, INC.
1515 So. Manchester Avenue
Anaheim, California

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SECTION 1
DESCRIPTION AND CHARACTERISTICS

1-1. GENERAL

The Ling Electronics Model S-10 Servo Control Amplifier is one component chassis of a servo system, used in vibration testing; it maintains one or more vibration quantities constant at an electronically driven shaker. (The quantity to be controlled is determined by one or more Ling Model S-12-D and G Servo Amplifiers; if automatic signal selection of D or G quantities is desired, one or more Ling Model DA-10 D and G Signal Selectors are used.) A sinusoidal signal input is applied to the power amplifier via the Model S-10 Servo Control Amplifier, which controls the amplitude of the sine wave signal fed to the power amplifier. The AGC signal controlling the Model S-10 Servo Control Amplifier output is supplied from shaker mounted accelerometers, via the Model S-12 D and G Servo Control Amplifier.

1-2. PURPOSE

The purpose of the Model S-10 Servo Control Amplifier is to control the amplitude of a sinusoidal signal, in a vibration testing system, in response to an AGC signal received from external equipment.

1-3. CHARACTERISTICS AND SPECIFICATIONS

All components of the Model S-10 Servo Control Amplifier, including the power supply, are contained in one rack mounted chassis. All necessary controls and indicators are located on the front panel.

Power Requirements	115 vac, 60 cps, 80 va
Input Voltage	1.0 volt rms (nominal)
Input Impedance	1.0 megohm
Output Voltage	5.0 volts rms maximum, actual voltage depends upon the control voltage.
Hum and Noise	60 db below 1.0 volt rms
Signal Channel Gain	+15 db to −30 db
Control Accuracy	±0.25 db for a 20 db change (20 db can be compressed to within 0.5 db). ±0.5 db for a 40 db change (40 db can be compressed to within 1 db).
Control Range	Greater than 45 db
Reaction Time	.04 seconds for 90% correction of a 40 db increase in control function.
Distortion	0.5% maximum at 1.0 volt output.
Frequency Range	5 to 5000 cps
Weight	Approximately 30 pounds

1-4. TUBE COMPLEMENT

REFERENCE SYMBOL	TYPE	FUNCTION
V1	6SN7GTB	Amplifier/phase inverter
V2	6L7	Balanced Variable gain Amplifier
V3	6L7	Balanced Variable gain Amplifier
V4	6SN7GTB	Phase inverter/cathode follower
V5	5687	Amplifier/cathode follower
V6	6SN7GTB	Input control signal amplifier
V7	6SN7GTB	Control signal amplifier and phase inverter
V8	6SN7GTB	Push-pull cathode follower
V9	6H6	Control signal rectifier
V10	6H6	Control signal rectifier
V11	OC3/VR105	Reference tube, voltage regulator
V12	6SH7	Amplifier tube, voltage regulator
V13	6Y6G	Series regulator
V14	5Y3GT	Rectifier tube, power supply

SECTION 2
OPERATION

2-1. INSTALLATION (see figure 2-1)

a. The Model S-10 Servo Control Amplifier is shipped with all tubes in place and ready to operate. A visual inspection should be made after unpacking for evidence of shipping damage, loose knobs, tubes or components.

b. The Model S-10 Servo Control Amplifier is designed for rack mounting and is installed according to instructions applicable to the system. Connections are made to plugs and to the terminal strip on the rear of the chassis. (See figure 4-1A, page 4-3)

PLUG	CONNECTION
J1	Signal input
J2	Signal output

TERMINAL NO.	CONNECTION
1	Chassis ground
2	Circuit ground
3	115 vac
4	115 vac
5	External control current meter +
6	External control current meter –
7	Control signal input
8	115 vac output (via switch S1 from terminal 3)
9	Spare
10	Spare

c. Plug connections are pin 1, circuit ground; pin 2, signal; pin 3, chassis ground. A shielded pair audio cable is recommended, with the inner shield tied to pin 1 and the outer shield tied to pin 3.

2-2. FRONT PANEL CONTROLS, INDICATORS AND METERS (See figure 2-2)

PANEL MARKING	REFERENCE SYMBOL	DESCRIPTION AND FUNCTION
POWER	IS1	INDICATOR. Shows when power is applied to the Model S-10 Servo Control Amplifier.
GAIN REDUCTION	M1	MILLIAMMETER. Indicates plate current of the gain controlled stage, calibrated in db of gain reduction.
MODE SELECTOR	S1	ROTARY SWITCH. A three position switch having OFF, NORMAL and BELOW 10 CPS positions. The OFF position controls power applied to the chassis.

2-3. OPERATING PROCEDURES

The Model S-10 Servo Control Amplifier is normally a part of an overall servo system; its operation is in conjunction with the other units of that system. The operating procedure to be followed is covered in the instructions for the servo system in use.

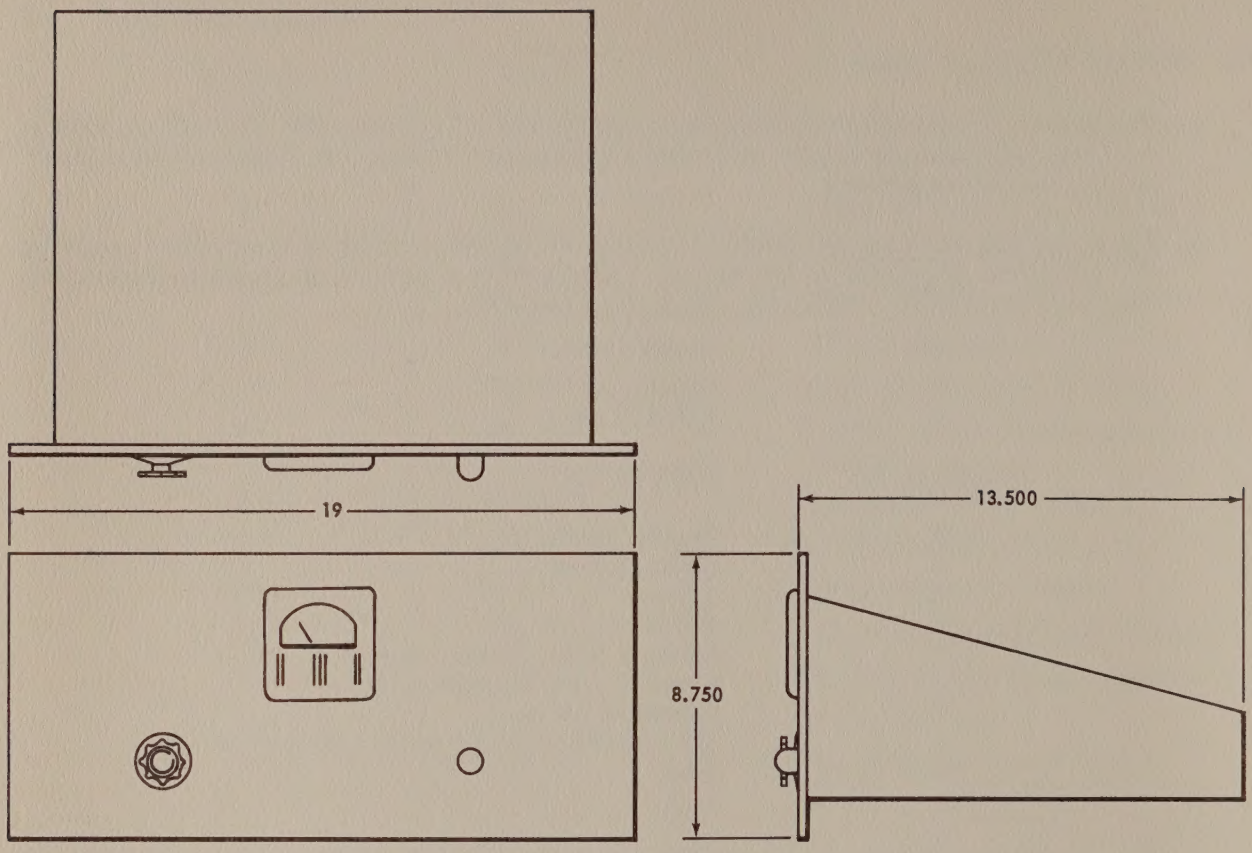


Fig. 2-1 Model S-10 Servo Control Amplifier, Dimensional Drawing

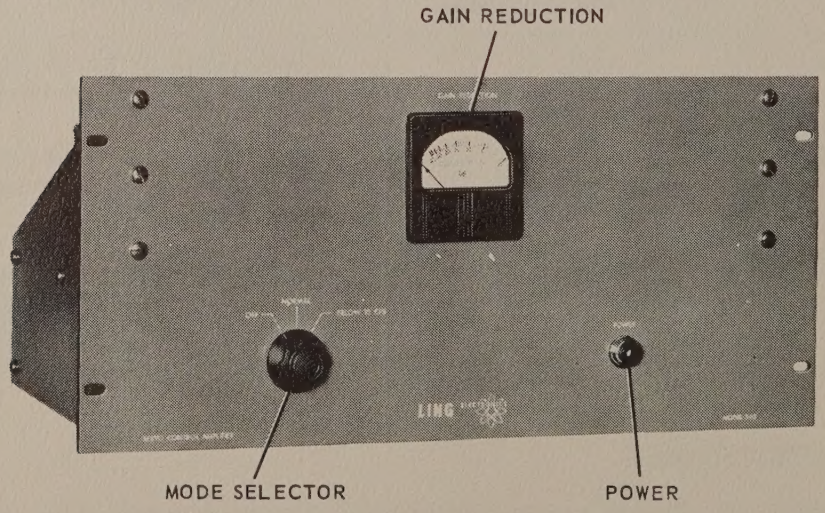


Fig. 2-2 Model S-10 Servo Control Amplifier, Front View

SECTION 3
PRINCIPLES OF OPERATION

3-1. INTRODUCTION (See figure 3-1)

a. The Ling Model S-10 Servo Control Amplifier is a gain controlled amplifier having a dynamic range of signal compression greater than 45 db. Gain control is achieved through use of a pair of variable transconductance tubes in balanced circuit. This circuit is designed to be as free as possible from transient effects resulting from gain changes. The Model S-10 Servo Control Amplifier has two channels; the signal channel, and the control channel.

b. Control signals (AGC) are received from a unit such as the Ling Model S-12 D and G Servo Control Amplifier. The Model S-12 D and G Servo Control Amplifier unit acts upon velocity and/or acceleration inputs, from accelerometers, to produce control signals proportional to acceleration or displacement. The control signal applied in the Model S-10 Servo Control Amplifier is usually proportional to either displacement or acceleration; in special configurations it could be proportional to velocity. The signal applied to the Model S-10 Servo Control Amplifier is a sinusoidal signal that has the same frequency as the actual vibration taking place at the shaker; hence (assuming a linear system) the same frequency as the signal to be controlled. The AGC control signal is converted within the Model S-10 Servo Control Amplifier into a dc control signal proportional to the peak-to-peak amplitude of the ac control signal. This dc control signal is applied, through filters that control the time constant of control, to the variable gain stage in the Model S-10 Servo Control Amplifier.

c. An oscillator applies a constant voltage sine wave to the Model S-10 Servo Control Amplifier. This signal supplies the required drive signal to the amplifier, controlled by the variable gain control channel. The control channel provides the overall control for the servo in response to an AGC signal.

d. The Model S-10 Servo Control Amplifier is designed to handle sinusoidal signals only and is not applicable to random wave signals. In random plus sine wave signals, the Model S-10 Servo Control Amplifier controls only the level of the sine wave signal before it is mixed with the random wave signal.

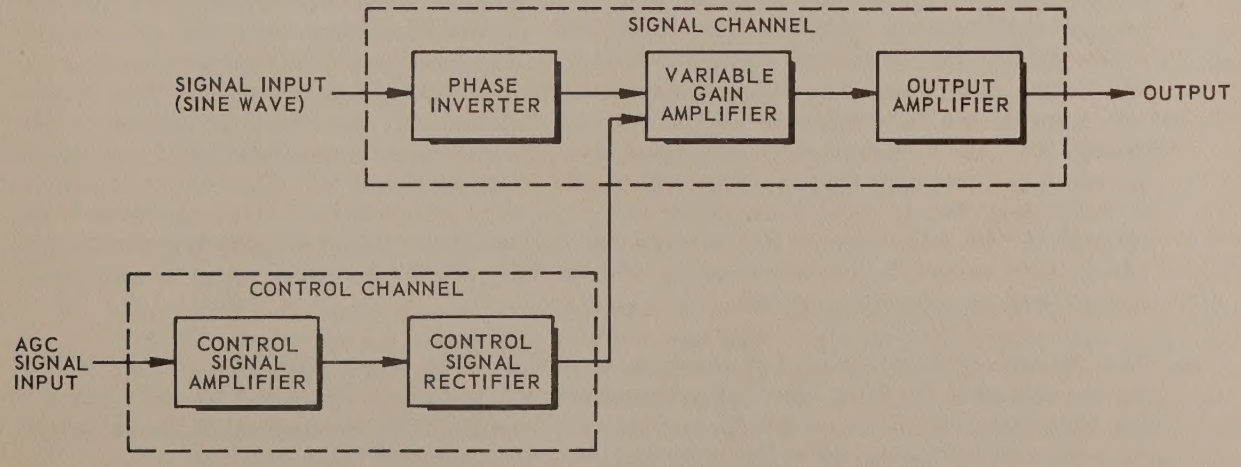


Fig. 3-1 Model S-10 Servo Control Amplifier, Block Diagram

3-2. GAIN REDUCTION (See drawing 4090)

The GAIN REDUCTION meter indicates that the servo system is operating within the specified operating range. If gain reduction is either too small or too large, the servo is close to being driven out of range so it can no longer control the level of vibration at the shaker. The operating point for this meter is adjusted by setting the amplifier master gain control; this control establishes the signal level within the closed feedback loop which is the servo. The servo acts to maintain a constant level of vibration regardless of the master gain control setting; as the master gain control is advanced, tending to produce a higher signal and higher vibration level, the servo action decreases this signal by a corresponding amount; the reverse is also true. The gain reduction is indicated by the GAIN REDUCTION meter; it should be within −3 db and −30 db for all frequencies in the operating range of the equipment. If the shaker resonances or other system responses are beyond the total dynamic servo operating range, these responses must be equalized by the appropriate filters or a manual correction of the gain, in the vicinity of these points, will be necessary.

3-3. MODE SELECTION (See drawing 4090)

The OFF position of the mode selector switch (S1), turns off the ac power to the Model S-10 Servo Control Amplifier as well as to the other components (when connected to be controlled by this switch) of the servo system. The NORMAL position establishes a fairly short time constant in the servo control loop; this time constant is used at all ordinary signal frequencies. With the switch in the BELOW 10 cps position, the time constant is increased by a factor of 3.5 and control of very low frequency signal inputs can be achieved without distortion as would occur with the switch in the NORMAL position. There are many cases where operation of the servo system, in the BELOW 10 cps position, is justified even at signal frequencies above 10 cps; in these cases, refer to the servo system manual.

3-4. SIGNAL CHANNEL (See drawing 4090)

a. The signal channel is shown in the upper portion of schematic 4090; it consists of tubes V1, V2, V3, V4 and V5. Signal from a suitable source (such as the Ling Model CO-10A Cycling Oscillator or from a tape recorder) is connected to the input connector (J1); it is amplified and transformed into a balanced signal by split load phase inverter V1. The balanced signal is applied to the control grids of balanced amplifier V2 and V3. These tubes must be carefully selected to ensure a balanced signal and to reduce the effects resulting from changes in gain. The output of the balanced gain controlled stage is applied to the phase inverter (V4). V4 has two outputs; one from the plate of V4A through R25, and the other from the cathode of V4B through R27. Each section of V4 has equal plate and cathode resistors (when R71 is properly adjusted) and acts as a phase inverter with a gain of approximately 0.9. The voltage appearing at the plate of V4A is equal in magnitude and of the same phase as the voltage appearing at the cathode of V4B. Adjustment of R71 ensures that the magnitudes are equal; thus the two voltages add linearly across the common coupling resistor R26 and the balanced signal is once again converted to an unbalanced signal.

b. The voltage developed across R26 is capacity coupled by C6 to amplifier V5A; the gain of V5A is approximately 10. This signal is capacity coupled to cathode follower V5B. R77 and R78 are connected from B+ to ground to establish the bias for V5B. The cathode follower couples the output signal through C8 to the power amplifier via connector J2.

3-5. CONTROL CHANNEL (See drawing 4090)

a. The control channel is shown in the lower right hand portion of schematic 4090. The control signal (AGC) enters on TB1-7 and is proportional to either displacement or to acceleration. V6 is a gain stabilized amplifier, with negative feedback supplied from the cathode of V7A via R38 and potentiometer R33 to the cathode of V6A; R33 adjusts the gain of the amplifier. V7 is a phase inverter with balance control potentiometer R72 in the grid circuit of V7B. Outputs from V7A and V7B are coupled to balanced cathode follower V8. The grid resistors for V8 are returned to a point above ground in the cathode circuit to establish the proper operating point for each tube; this connection also raises the input impedance somewhat and lowers the output impedance slightly.

b. Output of cathode follower V8 is capacity coupled to bridge rectifiers V9 and V10. V9A and V10A conduct on the positive half cycles if the voltages at the cathodes of V8 are sufficiently positive; this acts as a clamp on the AGC circuit, establishing a threshold level. When the cathodes of V8 swing toward a zero potential, the charge stored in coupling capacitors C14 and C15 causes the cathodes of V9B and V10B to become negative. If C25 is not fully charged, the diode conducts and charges C25 negatively with respect to ground. C25 may charge rapidly through the relatively low impedance of cathode follower V8 and the forward resistance of diodes V9B and V10B; C25 discharges through R64 and the network associated with switch S1A. This accounts for the shorter time constant on an increasing control function than on a decreasing control function.

c. S1A has two main positions, other than the OFF position, which removes power from the amplifier; these are the NORMAL and BELOW 10 CPS positions. The NORMAL position discharge time constant is determined by R64, C25 and C30; R70 has a very high resistance and serves only to keep C2 charged to the approximate discharge voltage; this avoids transient problems when switching S1A. The BELOW 10 CPS position shorts out resistor R70 so the total capacitance of the discharge circuit is increased to 3.5 times its previous value (from 4 mfd to 14 mfd). The BELOW 10 CPS position is used mainly for audio frequencies below 10 cps where the fast reaction time of the servo tends to cause gain correction during one cycle of the signal, which may produce distortion; this longer time constant is useful in certain higher frequency situations and may be of help in maintaining over-all stability of the vibration testing system.

d. The output from the integrator circuit (R64, C2 and C3) is applied to the No. 3 grids of V2 and V3 as a negative signal; it is also applied to the returns for the No. 1 grids. This signal controls the transconductance of each 6L7 in the same direction; the higher the control voltage across C3, the less gain produced by the 6L7's and the greater the compression. An increasing control signal amplitude at TB1-7 produces a decrease in gain, or an increase in compression of the amplifier; this compression is in the correct direction to cause the servo to function degeneratively and to control the vibration level in the proper manner.

3-6. POWER SUPPLY (See drawing 4090)

a. The Model S-10 Servo Control Amplifier has its own regulated power supply, operated from a 115 vac source. Power is supplied to TB1-3 and TB1-4 by a second deck of switch S1; when S1 is in a position other than OFF, C20 and C21 bypass the ac line to ground; this removes any power line noise that might otherwise enter the circuits. As an added precaution, shielded leads are used for the input power wiring. V14 is a conventional full wave rectifier circuit, with a two stage capacitor input filter comprised of C19, C27, C22, C28, L 1 and L2. The unregulated power supply output feeds V7 and V8; this voltage provides for the large plate swings required of these stages. V13 us a series regulator tube that receives its control signal from amplifier V12. A

portion of the screen voltage for V12 is derived from the unregulated side of V13 by resistor R57; this improves regulation of voltage changes, including ripple. Grid voltage for V12 is approximately half the output voltage and is taken by potentiometer R61, between the output voltage and ground. Any change in output voltage is divided approximately 2:1 and appears as a change in the grid potential of V12. The combination of V12 and V13 change the output voltage in the opposite direction. The loop gain of the regulator, comprised of the gain in V12, V13 and the loss in the output divider, determines how closely the regulated voltage remains to a constant value. Drift in the reference voltage across V11 appears multiplied by the divider ratio as a change in the output voltage. In this particular circuit the space current of V12 also must pass through V11, R73 and to some extent the screen divider; this allows an extra 17 MA to pass through V11 and changes in the gas tube current are small in comparison to the total current. Capacitor C17 bypasses the output divider and passes ripple and higher frequencies; this increases the loop gain and improves regulation.

b. Voltage divider R66 and R67 supply a bias of approximately 70 volts to all heaters; this reduces the heater to cathode voltages and leakage. R68 is provided as a hum adjustment.

SECTION 4
MAINTENANCE

4-1. ANALYSIS

a. The first step in servicing a defective Model S-10 Servo Control Amplifier is to localize the fault. Some faults, such as burned out resistors, arcing and shorted transformers can be located by sight, smell or hearing.

b. Listed below are a group of tests arranged to simplify and reduce unnecessary work and aid in tracing a trouble to a specific circuit or component.

(1). Visual inspection may disclose the trouble or determine the circuit in which the trouble exists.

(2). Voltage and resistance measurements will help to locate the defective component(s) when the readings are compared with the normal readings shown on the chart (see tables 4-1 and 4-2).

(3). Troubleshooting symptoms are listed in paragraph 4-2 to aid in determining the defective part.

(4). Intermittent conditions should not be overlooked when conducting these tests. This type of trouble may often be made to appear by tapping or jarring the equipment.

4-2. TROUBLESHOOTING (See figures 4-1A and 4-1B)

The following troubleshooting procedures are meant to be a basic guide to the possible root of troubles encountered:

TROUBLE	LOCATION	CAUSE AND/OR REMEDY
Unit does not come on when power is applied.	External	Check voltage at TB1-3 and TB1-4.
	Internal	Check fuse F1. Check for defective power transformer (T1).
Fuse F1 blown.	Internal	Check for defective rectifier tube (V14). Check for defective filter capacitors (C19, C22, C27 or C28). Check for defective power transformer (T1).

TROUBLE	LOCATION	CAUSE AND/OR REMEDY
Power supply will not regulate or adjust to 230 volts.	Internal	Check reference tube V11. Check regulator amplifier V12. Check series regulator V13. Check for excessive drain on supply; possibly C18 is defective. Check for defective potentiometer (R61). Check for defective capacitor (C71).
Output has dc transients as a result of AGC action.	Internal	Check balance in signal amplifier; repeat balancing procedure. Check V2 and V3 for balance.
No AGC action, but signal passes without effect.	External	Check input signal to the control channel.
	Internal	Check control signal amplifier V6 and V7. Check cathode follower V8. Check bridge rectifier V9 and V10. Check for shorted or leaky capacitors (C25 or C3).
Excessive noise or hum.	Internal	Check for heater to cathode shorts in all tubes. Check dc bias level on filaments; possible bad divider (R66 and R67) or potentiometer (R68). Check ripple on power supply. Check for noise or oscillation in reference tube V11.
Excessive distortion of low frequency signals (5 to 15 cps).	Internal	Check setting of S1; should be in BELOW 10 CPS position. Check R70 and C2.

b. Voltage and Resistance Measurements. (See figure 4-2 and tables 4-1 and 4-2)

(1) Tables 4-1 and 4-2 list all of the voltage and resistances present on the Model S-10-B Servo Control Amplifier tube sockets and terminal numbers. These measurements were taken under the following conditions:

(a). Point-to-point measurements are made from TB1-1.

(b). Jumper TB1-1 to 2, 7, and J1-2 and J2-2.

(c). Set the function switch to NORMAL.

(d). All other adjustments are determined by calibration.

(2). Measurements are taken with a 5000 ohm/volt meter on ac and a 20,000 ohm/volt meter on dc. Refer to Ling schematic 4090 for additional information.

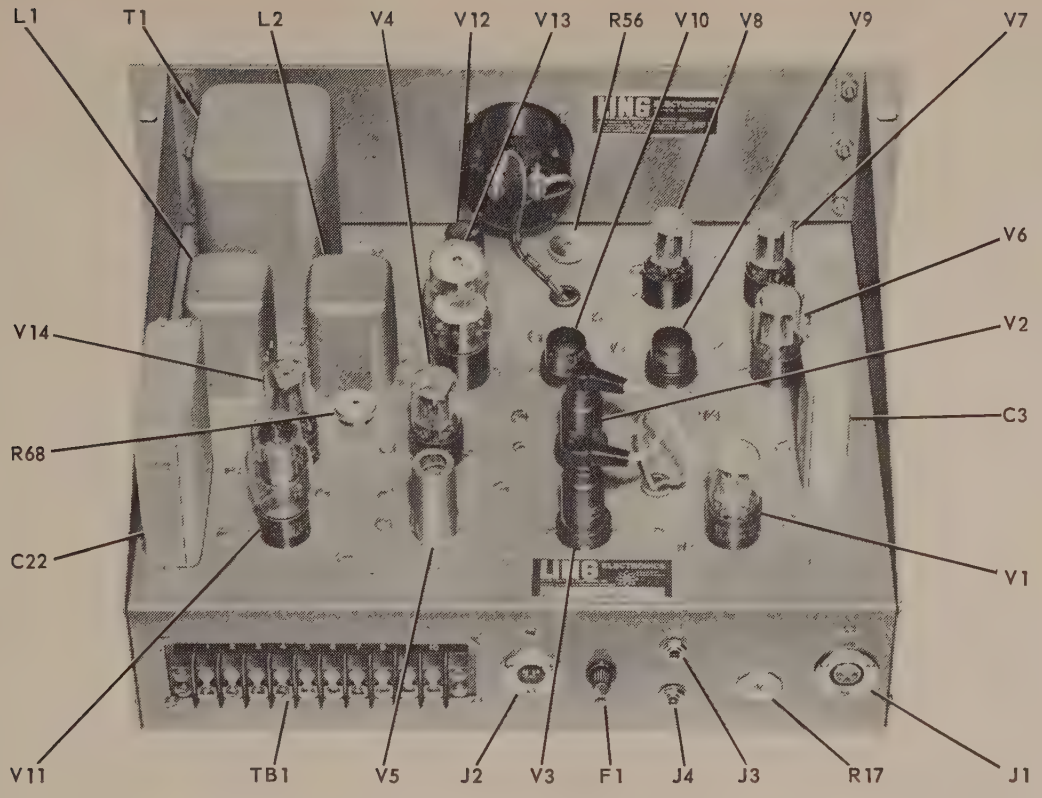


Fig. 4-1A Model S-10 Servo Control Amplifier, Top View

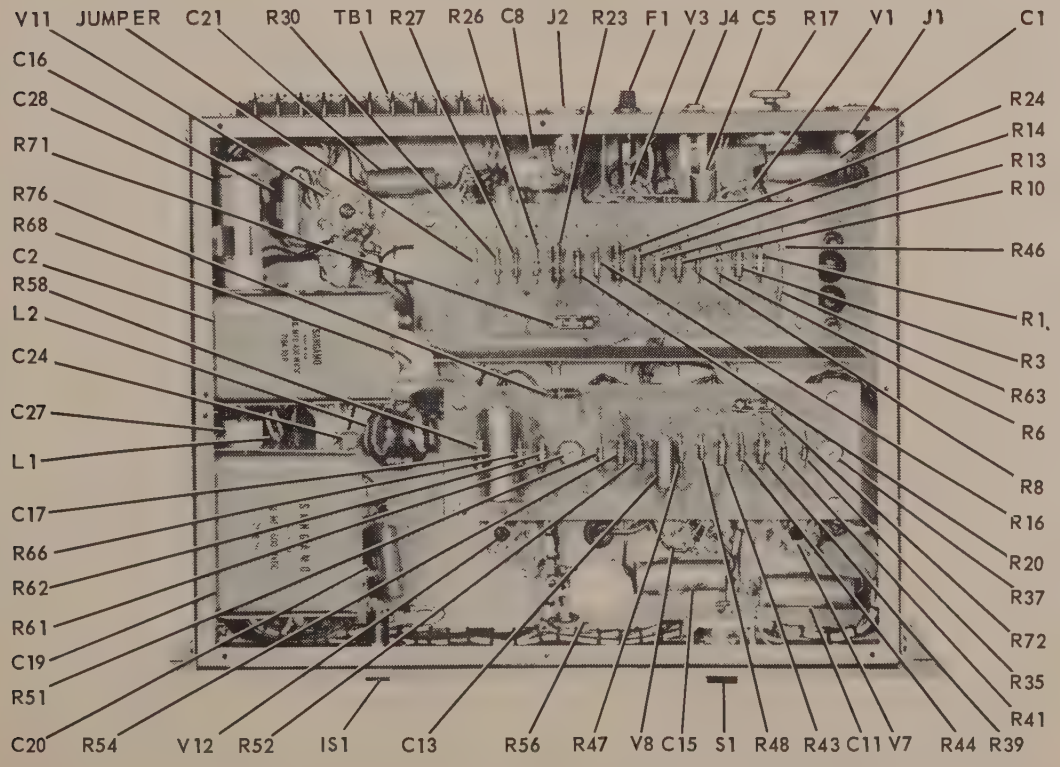
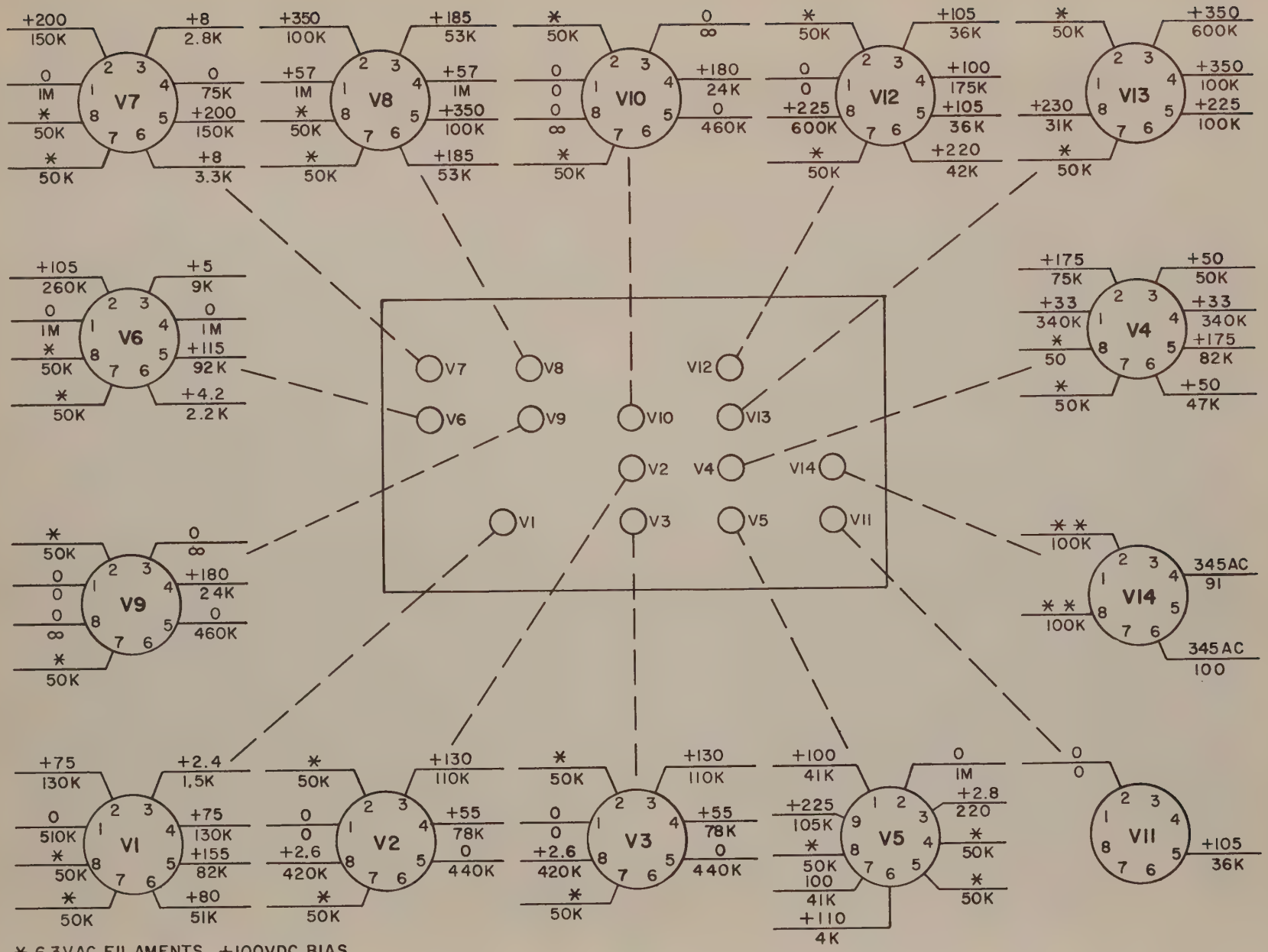


Fig. 4-1B Model S-10 Servo Control Amplifier, Bottom View



* 6.3VAC FILAMENTS, +100VDC BIAS
** 5.0VAC FILAMENTS, +360VDC

Fig. 4-2 Model S-10 Servo Control Amplifier, Voltage and Resistance Chart.

TABLE 4-1
Model S-10-B Servo Control Amplifier Voltage Checks

TERMINAL NO.	1	2	3	4	5	6	7	8	9	10
J1	0	0	0							
J2	0	0	0							
TB1-	0	0	*	** *	+230	+230	0	**	---	---

* 115 VAC input.
** 115 VAC output (TB1-4 to TB1-8)

TABLE 4-2
Model S-10-B Servo Control Amplifier Resistance Checks

TERMINAL NO.	1	2	3	4	5	6	7	8	9	10
J1	0	∞	0							
J2	0	10K	0							
TB1-	---	0	∞	∞	31K	31K	1M	∞	---	---

4-3. TEST EQUIPMENT

The following equipment is required for troubleshooting, adjusting or testing the Model S-10 Servo Control Amplifier:

(1). Audio oscillator, Hewlett Packard Model 200AB or equivalent.

(2). Audio oscillator, Hewlett Packard Model 202C or equivalent.

(3). Multimeter, Simpson Model 270 or equivalent.

(4). Distortion Analyzer, Hewlett Packard Model 330B or equivalent.

(5). Oscilloscope, Hewlett Packard Model 120 or equivalent.

(6). Microswitch for the triggered switch.

(7). A 0.01 mfd, 100 volt capacitor to decouple the input.

4-4. TESTING AND CALIBRATION

a. Preliminary Connections. (No power)

(1). Turn the meter adjust screw of M1 until the needle rests on the left hand zero mark (do not adjust to 0 db which is full scale). The chassis must be in a normal mounting position for this adjustment.

(2). Turn the mode selector (S1) OFF.

(3). Connect a jumper from TB1-1 to TB1-2.

(4). Connect an external ground to TB1-1.

(5). Connect the positive lead of a 500 vdc voltmeter to the unregulated power supply (pin 3 of V13); connect the negative lead to TB1-1.

(6). Short TB1-7 to TB1-2.

b. Preliminary Checks. (Power applied)

(1). Apply power by placing S1 in the NORMAL position.

(2). Remove power immediately if any of the following fail to occur:

(a). The unregulated power supply voltage should rise to approximately 360 volts.

(b). POWER indicator IS1 should light.

(c). All tubes should light.

(3). Measure the regulated dc voltage on TB1-5; adjust R61 for 230 vdc B+.

(4). The regulated power supply voltage will not vary appreciably for a line voltage variation of 105 to 120 vac.

(5). Adjust R56 for 180 vdc on pin 4 of V9 or V10 (AGC threshold bias).

(6). Adjust R17 for zero db reading on M1.

(7). Remove the short from TB1-2 and TB1-7.

(8). Connect the oscillator to TB1-7; adjust the oscillator for 0.7 volts rms at 100 cps on TB1-7.

(9). Adjust R33 for a reading of −15 db on M1.

(10). Observe the waveform at pin 5 of V9 or V10; adjust R72 for a ripple frequency of 200 cps (twice the input frequency) and balance the waveform peaks.

(11). Readjust R33 for a reading of −15 db on M1, if necessary.

c. Amplifier Balance.

(1). When balancing the amplifier, control the conditions of the test to get consistant evaluation. Readjustment of gain reduction levels and M1 zero may be required. Allow the AGC

circuits to recover fully after each observation. Demodulation products arising from the AGC action will appear in the output if the balanced amplifier stage is not dynamically balanced. The following steps provide a means for adjustment and evaluation of the amplifier balance.

(a). Measure the rms value of hum and noise at the output of J2 (TB1-7 shorted to TB1-2 and J1-1 shorted to J1-2). Adjust R68 for minimum reading; it should be less than one millivolt.

(b). Connect a normally open micro switch in series with the signal to TB1-7.

(c). Connect a dc oscilloscope to J2. Set the oscilloscope to observe a transient of approximately 50 MV peak-to-peak. A slow triggered sweep will be best.

(d). To obtain a reading of −30 db on M1, close the micro switch and increase the input to TB1-7. Release the micro switch.

(e). Close the micro switch and observe the transient at the output; it should not exceed 50 MV peak-to-peak. The transient should be balanced around the zero axis.

(f). If the Model S-10 Servo Control Amplifier will not meet the conditions of step (e) try the following:

1. Adjust R71.
2. Interchange V2 and V3.
3. Interchange the grid caps on V2 and V3.
4. Select new balanced pairs for V2 and V3.
5. Readjust R17 for zero db reading on M1 with zero input to TB1-7.
6. Readjust R33 for a −15 db reading on M1 with 0.7 volts input to TB1-7.

(g). Repeat step (a).

d. GAIN

(1). Connect an oscillator (or oscillators) to J1 and TB1-7. (Two oscillators or a single oscillator with two outputs and individual level controls may be used.)

(2). Adjust the input to J1 for 0.7 v rms. With zero input to TB1-7, the output at J2 should be approximately 4 v rms.

(3). Increase the input to TB1-7 (in steps) observing M1 and the output at J2. The reduction in output at J2 should correspond within ±10% of the reading on M1.

e. Control Sensitivity.

(1). Check the exact value of input to TB1-7 to give 15 db gain reduction as observed at the output of J2.

(2). Check the value required to give 40 db gain reduction.

(3). Express this as a percentage from this formula:

$$\frac{E_{40\,DB} - E_{15\,DB}}{E_{15\,DB}} \times 100 = _____\ \%$$

this should be less than 8%.

f. Distortion.

(1). Adjust TB1-7 input to 0.7 volts and J1 input to 1 volt. Measure the distortion at the output of J2; it should be less than 1%.

(2). Increase the input to J1 and measure the distortion at J2 to determine the input level at which distortion is 1.5%.

g. Frequency Response.

(1). Apply a constant input of 1 volt to J1 and zero input to TB1-7; vary the frequency from 5 cps to 5 KC. The frequency response should be flat ±3 db from 5 cps to 5 KC.

(2). Remove the input to TB1-7 and connect J2-2 to TB1-7; connect a 0.01 mfd capacitor from TB1-7 to TB1-2.

(3). Connect a 0.22 mfd capacitor across C6 (0.022).

(4). While varying the frequency from 5 cps to 5 KC, adjust the input to J1 to read between −10 db and −20 db. Do not exceed 1.5 volts input at any time. Measure the voltage at TB1-7; it should be approximately 0.7 volts constant, ±0.01 volts. Allow the amplifier to stabilize after each change of frequency; switch to the BELOW 10 cps position when necessary.

h. BELOW 10 cps Check.

(1). Apply an input frequency of 100 cps; increase the J1 input abruptly. Note the attack and release times in NORMAL and BELOW 10 cps; they should be approximately three times longer in the BELOW 10 cps position.

4-5. ADJUSTMENTS

a. Hum Adjustments.

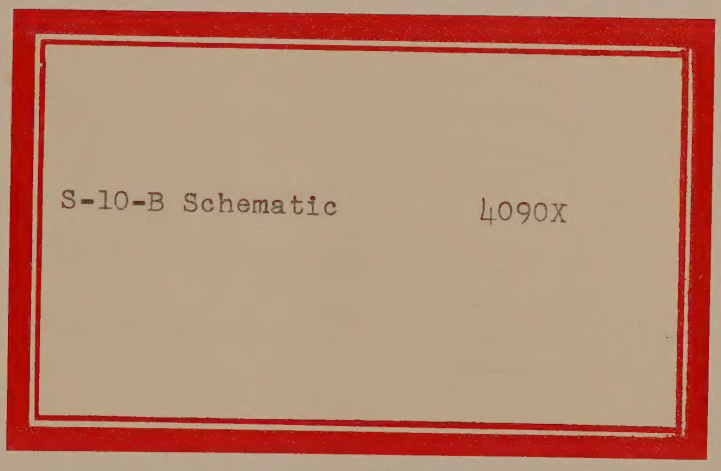
(1). Hum adjustment potentiometer R68, is located on the chassis near filter choke L2. To set this adjustment, short the input to J1 and place an oscilloscope or VTVM across the output (J2). Apply power and adjust R68 for minimum hum output.

4-6. CLEANING

The only cleaning necessary for the Model S-10 Servo Control Amplifier is to keep the chassis free of dust. To clean the chassis use low pressure air, a vacuum cleaner or a soft brush.

4-7. OTHER DIFFICULTY

In the event of troubles or problems not covered by this manual, contact the factory, giving serial number, Ling number, conditions of use, and a full description of the problem. Ling field service personnel are constantly available for consultation on special problems concerning utilization or application of Ling equipment.


S-10-B Schematic
4090X

MP MASTER
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